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(54) Title: A MODEM WITH IP SUPPORT

OUTGOING CALL A-->B
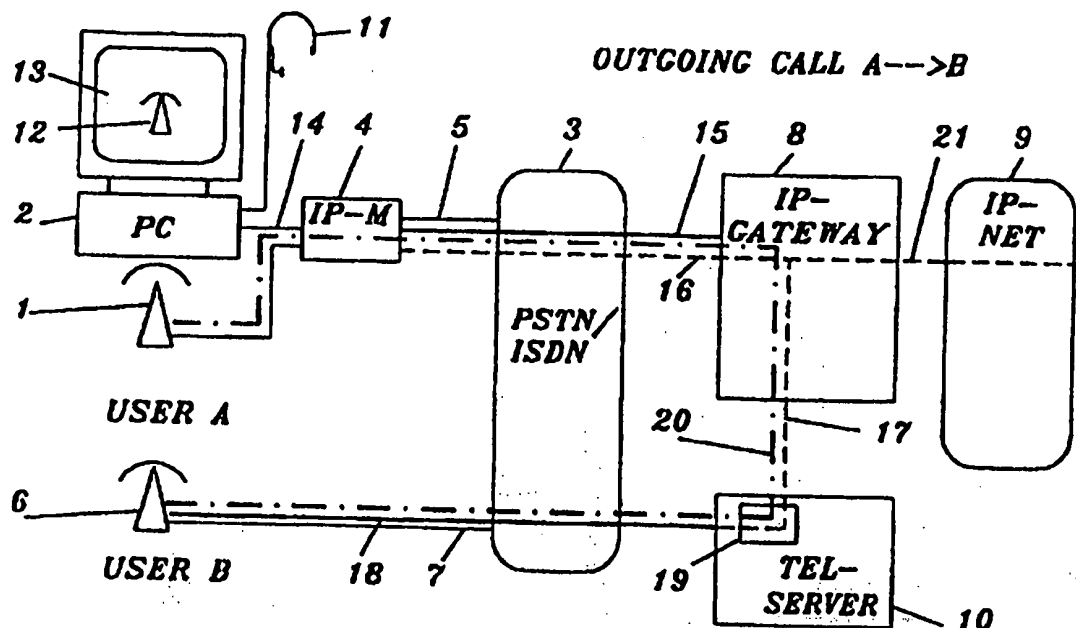
(57) Abstract

The invention relates to a modem (4) with IP support. It comprises access means for autonomous, simultaneous access to the services of a switched telephony network (3) and to the services of an IP based network (9). The autonomous, simultaneous access is established over a dialled up connection (15) and is provided using the IP protocol.

TITLE OF THE INVENTION

A modem with IP support

TECHNICAL FIELD OF THE INVENTION

5   The present invention relates to telecommunication in general
and to simultaneous voice and data communication using the
Internet protocols (IP). In particular the invention relates
to a modem which allows access to the PSTN network (or to the
ISDN network) and to IP-based networks from the subscriber end
10   of a subscriber line.

RELATED ART

A conventional data modem provides a digital bearer for
digital information. A conventional data modem is typically
15   connected between a computer and a subscriber line. A
communication application running on the computer provides
access to the Internet over PSTN. The subscriber line will be
busy to the PSTN network if the communication application is
involved in an ongoing IP session, such as surfing on the
20   Internet, sending or receiving e-mail, running an IP phone
application.

While an application is involved in an IP session it is not
possible to make an outgoing call from a normal telephone
25   connected to the same subscriber line as the modem because the
subscriber line is busy.

In reference [1] there is described a telephony server
allowing a user, which is involved in an IP session, to
30   receive telephony calls from the PSTN/ISDN network to a
personal computer used for the IP session. An incoming call
directed to any member of the user's family can only be
handled on the personal computer. It cannot be handled on
another telephone device. Likewise another member of the
35   family than the one engaged in the IP session cannot make an
outgoing call over the normal telephone.

A DSVD modem is a modem that allows for digital simultaneous transmission of voice and data on a single line. To achieve this properly a DSVD modem must communicate with another DSVD modem. A DSVD modem comprises means for multiplexing
5   packetized speech information and for sending the multiplexed information over a single link. A DSVD modem supports two independent sessions such as a telephony session simultaneously with an Internet session but has no means for accessing PSTN/ISDN services in order to establish such
10 parallel sessions. A DSVD modem does not support the control procedure of analogue phones such as for example control procedures for off hook, on hook, DTMF signalling (dual tone multifrequency signalling), generation of ring signals, generation of ring tones, hook flash signalling.
15

SUMMARY OF THE INVENTION

One object of the present invention is to provide a modem which allows an outgoing call as well as in incoming call on a normal telephone while simultaneously a communication
20 application running on a personal computer is involved in an ongoing IP session over the modem.

Still another object of the invention is to provide a modem for autonomous, simultaneous access to the services of a
25 switched telephony network, such as PSTN or ISDN, and to the services of an IP (Internet Protocol)based network, such as the Internet or an intranet, using the IP protocol.

Still another object of the present invention is to provide a
30 modem that has at least two analogue telephony interfaces so as to allow a subscriber to have two different telephones which can be operated independently and simultaneously.

Still another object in accordance with the invention is to
35 provide a modem allowing for internal telephony between a telephony application running on a PC and a normal telephone and allowing for internal telephony between two telephones

connected to the IP modem in a subscriber's home.

A further objective of the invention is to provide a modem
that allows connection to a home LAN (local area network in a
5   subscriber's home) using the IP protocol.

Still another objective of the invention is to provide a modem
that allows communication with devices, which are connected to
the home LAN and which all support communication using the IP
10   protocol, from an IP based network such as the Internet.

The above objects are attained with a modem of the general
kind indicated in the attached claims.

15   The modem in accordance with the invention uses, in an manner
known per se, the analogue transport capabilities of an
analogue subscriber line to provide a two directional, 28,8
kb/s, or higher, digital transport capability.

20   **BRIEF DESCRIPTION OF THE DRAWINGS**
Figure 1 is a block diagram of entities involved in an IP-
network session among these the modem in accordance with the
invention, a telephony server handling an outgoing call to the
PSTN/ISDN network,
25

Figure 2 is a block diagram similar to Figure 1; the
telephony server handling an incoming call from the PSTN/ISDN
network,

30   Figure 3 is a block diagram of the general protocol stack
used in the modem in accordance with the invention,

Figure 4 is a block diagram showing a specific protocol stack
used by the modem in accordance with the invention when a
35   telephony application is running,

Figure 5 is a block diagram of a home LAN (local area

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network) served by the modem in accordance with the invention;

Figure 6 is a circuit diagram of a safety feature of the modem in accordance with the invention,

5

Figure 7 is a functional block diagram of the modem in accordance with the invention,

Figure 8 is a block diagram of the preferred embodiment of an
10   hardware implementation of the modem in accordance with the invention, and

Figure 9 is a functional block diagram of the telephony in server.
15

DETAILED DESCRIPTION OF EMBODIMENTS

In Figure 1 a user A has a telephone 1 and a PC (personal computer) 2 both connected to PSTN/ISDN 3 via a modem 4 in accordance with the invention and via a subscriber line 5.
20   Another user B has a telephone 6 connected to PSTN via another subscriber line 7.

The modem 4 supports IP and related protocols, such as TCP (Transmission Control Protocols) and UDP (User Datagram
25   Protocol). The modem is placed at the home of subscriber A and will in the following be referred to as an IP modem.

In Figure 1 there is also shown a IP gateway 8, an IP based network 9 and a telephony server 10. The IP gateway is
30   connected to PSTN/ISDN 3 and to an IP network 9.

The reference PSTN/ISDN 3 refers to networks to which the IP gateway and the telephony server are connected. Examples of such networks are, besides from PSTN (Public Switched
35   Telephony Network)and ISDN (Integrated Services Digital Network), a private telephone network, a PBX (Private Branch Exchange). Examples of an IP network are the Internet and

intranet. Intranet is based on the technique by which Internet
is built and is used for spreading information internally
within an organization. Intranet uses IP and related
protocols.

5

The telephony server 10 is connected to the IP gateway 8 and
to PSTN/ISDN 3. The telephony server provides a telephony
service to users of the IP-network. The telephony server is of
the kind described in reference [1], contents of which is
10   incorporated herein by reference. To the extent that is
necessary for the understanding of the present invention the
operation of the telephony server will be described.

The IP-gateway serves as an gateway between PSTN/ISDN and the
15   IP network 9. The IP gateway 8 has physical connections with
the PSTN/ISDN, with the telephony server 10 and with IP-
network. For the sake of clarity these connections are not
shown in Figure 1. Over the connections between the telephony
server 10 and PSTN/ISDN speech to and from users is
20   transferred and signalling to and from PSTN/ISDN takes place.
The connections between the IP gateway and the telephony
server are constant, i.e. they are not established on a per
call basis. As an example the telephony server 10 is connected
to the IP-gateway via a non shown LAN and to the PSTN/ISDN
25   via an ISDN or PABX line interface. Over the connections
between the telephony server and the IP-gateway speech and
data information is transported using the IP protocol.

The PC is equipped with a non shown sound card to which audio
30   devices are connected. As an example of audio devices a
headset 11 is shown, said headset comprising ear phones and a
microphone. In Figure 1 a telephony application 12 is shown by
the telephone symbol at a screen 13 of the PC. The telephony
application 12 comprises software that runs on the PC. It
35   allows bi-directional voice communication over the sound card
and the headset. The telephone application in conjunction with
the PC and the sound card converts electrical voice signals

from the microphone into digitized and compressed audio
signals that are packetized into IP packets which are sent to
the IP modem 4. Conversely the telephony application
transforms IP packets containing digitized compressed audio
5   signals into analogue electrical signals which are supplied to
the ear phones of the headset. The audio signals supplied to
the sound card are processed by the PC and are exchanged with
the IP modem via IP protocol driver programs. A cable 14
connects the IP modem with a serial port of the PC.
10

For the moment it is assumed that telephony application is not
running on the computer. It is also assumed that the IP modem
is switched off.

15   **Activation of the IP modem**
Before the IP modem is used for traffic purposes it is
configured with the telephone number to the IP gateway 8 and
with user data relating to subscriber A. As an example user
data comprises the IP access user name of user A, a password
20   and an IP address to the telephony server.

When the IP modem is activated IP functionality residing
therein is activated. In order to get a clear understanding of
the IP modem functionality reference is made to Figures 1 and
25   4.

When the IP modem is activated: (1) the IP modem makes an
outgoing call to the IP gateway. A PSTN/ISDN connection 15 is
established. (2) The IP gateway accepts the call. (3) Over an
30   established, non-shown, V.34 connection a PPP (Point to Point
Protocol) link is established between the IP modem and the IP
gateway. Over the PPP link the IP gateway sets up a IP link 16
to the IP modem. (4) A telephony application resident in the
IP modem sends a message to the telephony server telling the
35   telephony server that a telephony application session shall
take place for the user telephone number at the IP address of
the IP modem. The message is sent in IP packets over one of

said constant IP connections. In Figures 1 and 17 this connection is labelled 17. A telephony application can use the services of the PSTN/ISDN network.

5   Now the IP modem has registered itself at the IP gateway and the IP gateway is now able to route IP messages which as destination have the IP address of the IP modem 4 to the IP modem. Simultaneously the IP modem is registered at the telephony server, allowing access to PSTN/ISDN services. When
10 the IP modem is registered at the telephony server one of the existing connections is assigned to the IP modem. The assigned connection is illustrated by an IP link 17.

In the Figures PSTN/ISDN connections are shown by heavy lines,
15 IP links by dashed lines and speech paths by heavy dashdot
    lines.

Outgoing call

Next user A wants to make an outgoing call and lifts the
20 receiver of telephone 1. The IP modem detects this event and sends a dial tone to telephone 1. The IP modem 4 has all hardware required for acting as a conventional line card to user A's telephone. The operations performed by the IP modem in this respect is to provide e.g. off hook, on hook, line
25 current, dial tone, ring signal, ring tone, hook flash (provided by R-key functionality in some telephony systems), and decoding of DTMF signals from telephone 1. It also has all necessary hardware and software for signalling to the telephony server in order to access the PSTN/ISDN services. In
30 the following this software is referred to as the IP modem's telephony application.

Next user A dials the number to user B. The digits are received by the IP modem's telephony application. The IP
35 modem's telephony application forwards the dialing information to a telephony application resident in the telephony server 10. The telephony server 10 interprets the dialing information

and makes an outgoing call in the PSTN/ISDN network 3. The
PSTN/ISDN network 3 sets up a PSTN/ISDN connection 18 to
subscriber B. The PSTN/ISDN network is sending ring signals to
subscriber B and the IP modem 4 is sending ring tones to
5   subscriber A. When subscriber B lifts the receiver the
PSTN/ISDN network detects this event and reports back to the
telephony server 10 which in turn reports back to the IP modem
4. A connection has now been established between A and B.

10   When A talks the speech is transferred to the IP modem in the
form of analogue signals. The IP modem, in a manner known per
se, converts the speech into digital signals. The digitized
speech signals are compressed using conventional speech
compression algorithms. The digitized compressed speech is
15   then packetized, by the IP modem 4, into IP packets which are
sent over the IP links 16, 17 to the telephony server 10. The
telephony server 10 has a converter 19 which converts received
speech packets into isochronous speech signals which are sent
over the PSTN/ISDN network to subscriber B.
20
When B talks the speech will be transferred to the telephony
server 10 as speech signals. The converter 19 converts the
speech signals into digitized, compressed information which
are sent in IP packets to the IP modem 4 over the IP links 17,
25   16. The IP modem receives the IP packets, unpack them and
decodes the speech information. Decoded speech signals are
sent to the telephone 1. The speech path between A and B is
shown by the dashdot line 20.

30   Coded speech will occupy only about 10-15 kb/s. The rest of
the band width available on said connections can be used for
other purposes.

As will be described further down the IP modem may
35   simultaneously with the call to B have another telephone
session running.

Simultaneously with the telephone call to B the IP modem may
have an ongoing session with the IP network 9 as exemplified
by IP link 21. As will be explained later the IP modem has
multiplexor/demultiplexor functions that multiplexes
5   information from different applications onto one and the same
IP link to the IP gateway and that demultiplexes received
information and forwards the demultiplexed information to
their respective destinations. For example the IP modem will
forward incoming IP packets from the Internet to an Internet
10 application running on the PC 2 and will forward incoming
packets containing speech information to the telephone 1 via a
decoder, decompressor and a d/a converter. IP packets to and
from the IP network will pass the IP gateway; they will not
reach the telephony server.
15

If user A is running the telephony application 12 on the PC
the sound card in the PC will deliver the sound, digitized,
compressed and packetized, in IP packets to a PC interface of
the IP modem 4. The IP modem 4 will forward them over IP links
20 16, 17 to the telephony server 10. In this manner user A may
use the PC and the headset as a telephone.

Incoming call
In this example it is supposed that the IP modem has been
25 activated and registered its presence at the IP gateway and
the telephony server. User A may or may not have an ongoing IP
session. For the sake of clarity it is supposed that no IP
session is taking place.

30 As mentioned in the previous example the IP modem will, when
activated, set up IP link 16, 17 to the IP-gateway and to the
telephony server. The IP modem's telephony application will
send IP packets to a telephony application running in the
telephony server. Among these there is one containing a
35 message requesting the telephony server to activate the
service "call forwarding" in the PSTN/ISDN network. Other
means to request the call forwarding service are described in

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reference [1]. On behalf of user A the telephony server 10
requests call forwarding service in the PSTN/ISDN network and
indicates as call forwarding number, i.e. the number to which
calls directed to A shall be forwarded, a telephone number of

5   the telephony server 10. When the call forwarding service has
been completed a call to user A's telephone number will be
routed by the PSTN/ISDN network to the telephony server 10.

User B wants to speak with user A over the telephone and dials

10 the telephone number to user A. PSTN/ISDN detects that calls
to A should be forwarded to the telephony server. A PSTN/ISDN
connection 22 to the telephony server is established. The
telephony server receives the call and notes it is directed to
user A. Using the above mentioned registration data of A, said

15 registration data comprising A's telephone number and A's IP
- address, the telephony server creates a relation between the
incoming call and the IP modem's IP address. Various methods
to accomplish this are described in reference [1]. Next the
telephony server sends IP packets to the IP modem over the IP

20 links 17, 16; said IP packets comprising an alert message.

The IP modem receives the alert message and generates in
response thereto a ring signal on A's telephone.

25 When A lifts the receiver the IP modem detects this event and
sends a corresponding message in IP packets to the telephony
server. A connection has now been established between B and A.
Speech signals are sent from B to the telephony server over
the PSTN/ISDN connection 22. In the telephony server converter

30 19 converts the speech signals into digitized compressed
signals which are packetized in IP packets which are sent from
the telephony server to the IP modem over the IP links 17, 16.
In the IP modem the received IP packets are unpacketized,
decompressed and converted into speech signals which are sent

35 to the telephone 1. B and A can now have a conversation. The
speech path is shown by the dashdot line 20 in Figure 2.

If A does not answer the call the IP modem 4 takes no action.
The telephony server continues to send ring tones to
subscriber B. When B places the receiver in the cradle of the
telephone 6 this event detected by the PSTN/ISDN which
5   releases the connection between 6 and 10.

Instead of generating a ring signal upon reception of the
alert message the IP modem itself may generate an audible
signal or may send an alert message to the PC which then
10   displays an alert message on the screen of the monitor 13.

Instead of answering the call user A may decide to redirect
the incoming call to a call handler as described in reference
[1].
15

When the conversation between A and B is finished the
PSTN/ISDN connection 22 and the speech path 20 is released.
The telephony server 10 releases the relation between the
incoming call and A's IP address. The PSTN/ISDN connection 15
20   remains.

To establish the correct relation between an incoming call and
the called user the telephony server must be given the
destination of the incoming call from the incoming call
25   itself. Several methods for achieving this are described in
reference [1].

If user B makes a call to user A and user B also has an IP
modem, then the call will be treated as a combination of an
30   outgoing call with an incoming call.

In Figure 3 various protocols used by the IP modem are shown.
In the IP modem there is one protocol stack per access type.
Thus there is one protocol stack 23 for access to the
35   subscriber line, one protocol stack 24 for access to the
telephone or telephones and one 25 for access to the PC.

The telephone protocol stack 24 comprises as the lowest layer
POTS (Plain Old Telephony Services)access "protocol" 26. If
the subscriber has two telephone accesses, i.e. there are two
telephones connected to different loops, then there is another

5   POTS access "protocol" 27, as indicated by the dashed line.
Over the POTS access layers there is a layer comprising
coding/decoding 28, labelled CODEC, and control 29 of signals
exchanged between the POTS layer and the uppermost telephony
application layer. The IP modem's telephony application 30

10   provides i.a. functions for handling incoming and outgoing
calls, functions for operating the specific telephone type
used, and functions for transfer of signals between the
telephone(s) and the PSTN/ISDN.

15   The subscriber line protocol stack 23 comprises, a bottom POTS
layer 31, over the POTS layer a V.34 protocol layer 32
providing i.a. common data exchange functions, over the V.34
layer a PPP (Point to Point Protocol) protocol layer 33, over
this an IP (Internet Protocol) layer 34, over the IP layer an

20   UDP/TCP layer 35(User Datagram Protocol and Transmission
Control Protocol respectively) and over the UDP/TCP layer the
telephony application layer. The UDP protocol is used for
voice transmission and the TCP protocol for signalling between
the telephony application layer and the IP layer. The

25   telephony application layer 30 is the uppermost protocol layer
of the subscriber line protocol stack and is common to the
subscriber line protocol stack and the telephone protocol
stack.

30   For the sake of clarity the control means by which a V.34
connection is established are not shown in Figure 4. Such
control means are resident in the IP modem.

As will be explained below there may be other applications
35   running in the IP modem. Such other applications are at the
same protocol layer level as the telephony application layer
and uses one or more of the underlying UDP/TCP, IP, PPP, V.34

and POTS protocols depending on the specific application. In
Figure 3 one such other application is shown at 36.

The PC protocol stack comprises, from the bottom, a serial
5   port interface layer 37, a PPP protocol layer 38 and as
uppermost layer the IP protocol layer 34.

Figure 4 illustrates how the protocols shown in Figure 3 are
used by the IP modem's telephony application 30 for
10 communication with the IP gateway and the telephony server. In
the IP modem the telephone protocol stack 24 and the
subscriber line protocol stack 23 are used. In the IP gateway
a protocol stack 39 is used for access to PSTN/ISDN and in the
telephony server a protocol stack 40 is used for access to the
15 IP gateway. The telephony server also has a non shown protocol
stack, similar to the subscriber line protocol stack, for
access to PSTN/ISDN. The latter protocol stack is not shown in
order not to destroy the clearness of Figure 4.

20 The lowest protocol layer of protocol stack 24 is the POTS
layer 26 which in this case is an analogue access interface
providing communication in PSTN/ISDN. Over the POTS layer is
CODEC 28 and CONTROL 29 layers. Over this latter layer is the
telephony application 30.
25
The lowest protocol layer of structure 23 is POTS layer 31
providing communication in PSTN/ISDN. Over the POTS layer 31
is the V.34 protocol layer providing a raw digital link on the
PSTN/ISDN connection 15. Over the V.34 protocol layer there
30 is the PPP protocol layer 33 allowing for transmission of IP
packets. Over the PPP layer is the IP protocol layer 34
allowing for handling of IP addresses. Over the IP layer is
the TCP/UDP protocol layer 35. In the IP modem the POTS access
protocol layer and the V.34 protocol layer are handled by a
35 standard data modem 41, the PPP protocol layer by a PPP
handler 42, the IP protocol layer by an IP handler 43 and the
TCP/UDP protocol layer by a TCP/UDP handler 44. Each one of

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the handlers 41, 42, 43 comprises software of known art.

The IP gateway protocol stack 39 for access to the PSTN/ISDN
network comprises, from the bottom, a POTS protocol layer 45,
5   a V.34 protocol layer 46, a PPP protocol layer 47 and an IP
protocol layer 48. The POTS and V.34 protocol layers are
handled by a modem pool 49, the PPP layer by a PPP handler 50
and the IP layer by an IP handler 51. The IP gateway has also
a non shown protocol stack for access to the non shown
10   constant IP connections to the telephony server. This non
shown protocol stack has an IP protocol layer which it shares
with IP protocol layer 48.

The telephony server protocol stack 40 comprises, from the
15   bottom, an IP protocol layer 53 and a UDP protocol layer 54.
In the telephony server these layers are handled by a PPP
handler, an IP handler and an UDP handler respectively. The IP
protocol layer 53 is carried by a non shown LAN interface.

20   The IP modem's telephony application 30 communicates with an
telephony application 55 in the telephony server using the UDP
protocol and the TCP protocol. Such communication is indicated
by the double headed arrow 56.

25   As indicated above the IP modem also may have one or more
other applications 36 which communicate with other similar
applications using the TCP protocol layer. An example of an
other application is an e-mail poller, polling the e-mail
boxes user A may have in the IP network 9. When there is mail
30   in a mailbox an indication is given, for example a visual
indication. Another example of an application is remote
handling of consumer devices, such as an electricity
consumption meter. Other examples will be given below with
reference to Figure 5.
35

In Figure 5 there is shown how the IP modem 4 in accordance
with the invention is used to provide internal communication

between two different loops to which user A has telephones connected. One loop is labelled 57 and another loop is labelled 58. Several telephones may be connected to loop. In Figure 5 one telephone 1 is shown to be connected to loop 57

5   and one telephone 59 is connected to loop 58. Each loop is connected to a respective physical port to the IP modem. Each port is operated by the telephony application 30. A telephone connected to loop 57 can therefore communicate with a telephone connected to loop 58. In the example shown

10   telephones 1 and 59 can communicate with each other. In this way intercom is provided by the IP modem. This is illustrated by double headed arrow 60.

In accordance with the invention the IP modem 4 has a LAN

15   application and therefore serves as a simple router of a home LAN 61 to which different devices are connected. Each connected device supports the TCP/IP protocol, in other words they "speak" IP, and can therefor communicate with other devices, remote from the LAN, provided said other devices also

20   support communication using the TCP/IP protocol.

In particular the telephony application 12 running on the PC can communicate with any of the two telephones 1, 59 via the IP modem. This is illustrated by the two double headed arrows

25   62, 63 . Intercom is thus provided between the headset 11 and any of the telephones 1, 59.

To the home LAN 61 an electricity consumption meter 64, a water consumption meter 65, a smoke and fire detector 66, a

30   stove 67 with an oven 68 are connected. This configuration allows remote handling, such as read out, of the electricity and water consumption meters. When the smoke and fire detector detects smoke an alarm telephone number, for example to a SOS alarm center or to the fire brigade, is automatically dialled

35   by the IP modem. With this configuration it will also be possible to remote operate the stove as well as the oven, e.g. from a PC with access to the IP network.

It goes without saying that the IP modem 4 supports a number
of features to enhance traditional telephony such as
abbreviated dialing numbers. An abbreviated dialing number may
5   include an IP address for an address which can be reached by
IP phone.

Basic telephone

The IP modem 4 operates into different modes depending on user
10   A's desires and depending on the kind of services required by
A. The IP-network and PSTN/ISDN network services available
from the IP modem have been described in connection with
Figures 1-5. In Figure 6 the basic telephony service is shown.
The IP modem 4 comprises a relay 69 with two moveable contacts
15   70, 71. Contact 70 is adapted to be connected the wall socket
in A's premises and from there to the subscriber line to the
local office. Contact 71 is adapted for connection to user A's
telephone loop 57. Each moveable contact can move between two
stationary contacts, two of which are interconnected by a
20   cable 72. When the moveable contacts are ·in the position shown
in Figure 5 basic telephony mode is provided. When the
moveable contacts are in their opposite positions the IP mode
described in connection with Figures 1-5 is provided. In the
position shown in Figure 6 a telephone connection is hard
25   wired through the IP modem. In this position A's telephone
apparatus will be connected, usually via a non shown wall
socket, to the subscriber line. When main power is down the
default mode of the IP modem will thus be basic voice
telephony. Basic voice telephony mode can also be manually
30   selected by user A, for example by flipping a non-shown switch
on the IP modem.

In Figure 7 a functional block diagram of the IP modem 4 is
shown. It comprises a PC interface 73/72 providing a serial
35   interface using the IP and PPP protocol layers 34, 38. Thus
the· PC interface supports exchange of IP packets. Instead of
·the serial PC interface 73 ·there may be a LAN interface·74

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shown by dotted lines.

There is also one telephone interface 75 for connection to
loop 57, one telephone interface 76 for connection to loop 58
5   and one subscriber line interface 77 for connection to the
analogue subscriber line. The telephone interfaces are
enhanced with capabilities to detect control signals from a
telephone, such as off hook, on hook, hook flash signals, DFTM
signals and to generate ring signals, dial tones and other
10 acoustic signals. The telephone interfaces convert the speech
into digital signals which are compressed, for example using
GSM compression, packetized and put into IP packets. Incoming
IP packets which carries speech are processed in the reversed
way. It should be noted that the safety device provided by
15 items 70, 71, 72 supports one telephone interface only, for
example telephony interface 75. The subscriber line interface
77 further comprises standard data modem capabilities to
provide for a bi-directional 28,8 kB/s or higher digital
transport capability.
20

There is also one or more application handlers 78, 79. In one
of them, for example 78, said other application 36, for
example the e-mail polling application, is residing. In the
other, other applications are residing, for example
25 applications which provide functionality required to operate
devices attached to the IP modem by way of the LAN 61. An
exemplary such other application is one that switches the oven
off when the smoke detector detects smoke.

30 There is also an IP MUX/DMUX functionality 80, also referred
to as IP router functionality, which takes IP packets from the
different interfaces and sends them in proper order to the
subscriber line interface 77. The IP MUX/DMUX functionality
also provides for reception of IP packets from the subscriber
35 line interface and for delivery of the received IP packets to
their proper interfaces. Finally there is an overall control
functionality 81 for controlling the operation of the IP

modem's various functionality's.

Local mode

When power to the IP modem is on and the modem has no

5   connection to the IP network 9 the modem is said to be in its
local mode.

If the IP modem is in its local mode intercom is possible
using the telephony application 30. The intercom possible in

10   the local mode is exemplified by arrow 60 in Figure 5,

In the local mode of the IP modem other applications 36 can
run on the home LAN. As an example the above mentioned
application that switches the oven off when smoke is detected

15   may be running on the LAN. In the local mode one such other
application 36, not necessarily anyone of those exemplified
above, can instruct the IP modem to set up a connection to the
IP network 9. As an example the e-mail polling application can
check if there is any e-mail to user A in a mail box. The mail

20   box is resident in the IP network. To check this the IP modem
makes a call to the IP gateway. When the connection has been
established the e-mail polling application sends an IP poll to
the mail box and communicates with it using IP. Such a call
may for example be made at regular intervals.

25
In the local mode of the IP modem an external application,
i.e. an application running on a communication device outside
of user A's home, can establish communication with an other
application 36 in user A's IP modem 4. As an example a mail

30   box in the IP network 9 can request an IP gateway to call the
IP modem 4 in order to deliver mail for user A. Another
example is an external application that reads the electricity
consumption meter 64 from a remote site. Upon reception of a
call from an external application the IP modem identifies the

35   caller, based on e.g. number identification, and as a result
of the identification the call is accepted or rejected. Is the
call from a valid IP session initiator the call is accepted,

otherwise it is rejected. Is the call accpted the IP modem
enters connected state mode and starts an IP session with the
external application. Connected state mode implies that the IP
modem is connected and communicates over the IP protocol

5   layer. If the call is rejected the IP modem remains in the
local mode.

In Figure 8 there is shown a physical implementation of the IP
modem 4. The control functionality 81 is implemented by a

10   microprocessor. Hardware and/or software is added for speech
encoding, e.g. GSM encoding. Likewise software for driving
telephone interface 75 is added to a non shown memory unit
that communicates with the CPU. In a preferred embodiment of
the invention the standard modem 41 and the coding/decoding

15   provided by the subscriber line interface 77 are implemented
       using DSP:s (Digital Signal Processors).

The IP MUX/DMUX function 80 is provided by the microprocessor.

20   The telephony server 10 shown in Figure 9.comprises a central
controller 82 , an access handler 83, a compression and
packetizing unit 84, an IP handler 85, PSTN/ISDN lines 86
connected to the PSTN/ISDN network and a number of lines 87
connected to the IP-gateway 8. Under control from the central

25   controller 82 the access handler receives incoming calls,
places outgoing calls, handles the telephone numbers of the IP
modem, requests the PSTN/ISDN network to activate and
deactivate the call forwarding service and provides
connections to the IP gateway 8. The compression and

30   packetizing unit converts the speech signals into digital
format, and vice versa, so that they can be subjected to
digital processing. Digitized speech signals are sampled using
conventional sampling technique and are subjected to
compression using a conventional speech compression algorithm.

35   Finally the sampled compressed digital signals are organized
into packets and sent to the IP handler 85 which provides the
packets with address and tails so as to form IP packets. The

IP handler 85 also controls the flow of IP packets to and from
the IP gateway. The IP handler handles the IP layer 53 in
Figure 4.

5   The lines 86, 87 are preferably digital lines such as ISDN
30B+D (primary rate B) or a digital PABX line (Private
Automatic Branch Telephone Exchange). To the telephony server
10 it does not matter whether the telephones 1, 6, 59 are of
analogue or digital type because PSTN/ISDN 3 will provide the
10   proper type of signals to the telephones. The telephony server
must, however, depacketize the compressed speech and
decompress it before it is sent as normal speech information
to the PSTN or the ISDN network.

15   References:
[1] Our co-pending Swedish patent application 9602212-4 filed
on June 4, 1996

CLAIMS

1. A modem characterized in that it comprises access means (30, 41-44, 73-75, 77) for autonomous, simultaneous access to the services of a switched telephony network (3) and to the
5   services of an IP based network (9), said autonomous, simultaneous access being established over a dialled up connection (15) and being provided using the IP protocol.

2. A modem in accordance with claim 1 characterized in that
10   said telephony network (3) an analogue or digital public or private telephony network.

3. A modem in accordance with claim 2 characterized in that said IP based network (9) is a public or private network.
15

4. A modem in accordance with claim 3 wherein said access means comprises a telephone interface (75) for connection to telephones (1), a PC interface (73) for connection to a PC, a subscriber line interface (77) for connection to a subscriber
20   line, characterized in that said telephone interface (75) provides telephony using the IP protocol.

5. A modem in accordance with claim 4 characterized in that it comprises means (75) for detecting and generating control
25   signals for a telephone and for transmission of voice information to said telephones (1).

6. A modem in accordance with claim 4 characterized in that said PC interface (73) in a manner known per se provides data
30   exchange using the IP protocol.

7. A modem in accordance with claim 4 characterized in that said access means further comprises an IP handler (43) for autonomously providing access to an IP gateway (8) and to a
35   telephony server (10), said telephony server being connected to said switched network, said IP gateway being connected to the telephony server and, in a manner known per se, to the

switched network as well as to said IP based network.

8. A modem in accordance with claim 9 characterized in that said access means further comprises a LAN interface (74) for connection to a LAN (61), thus providing access to devices (2, 64-68) with IP communication capabilities.

9. A modem in accordance with claim 4 characterized in that it comprises a number of applications (30, 36) each of which is supported by communication in said IP based network.
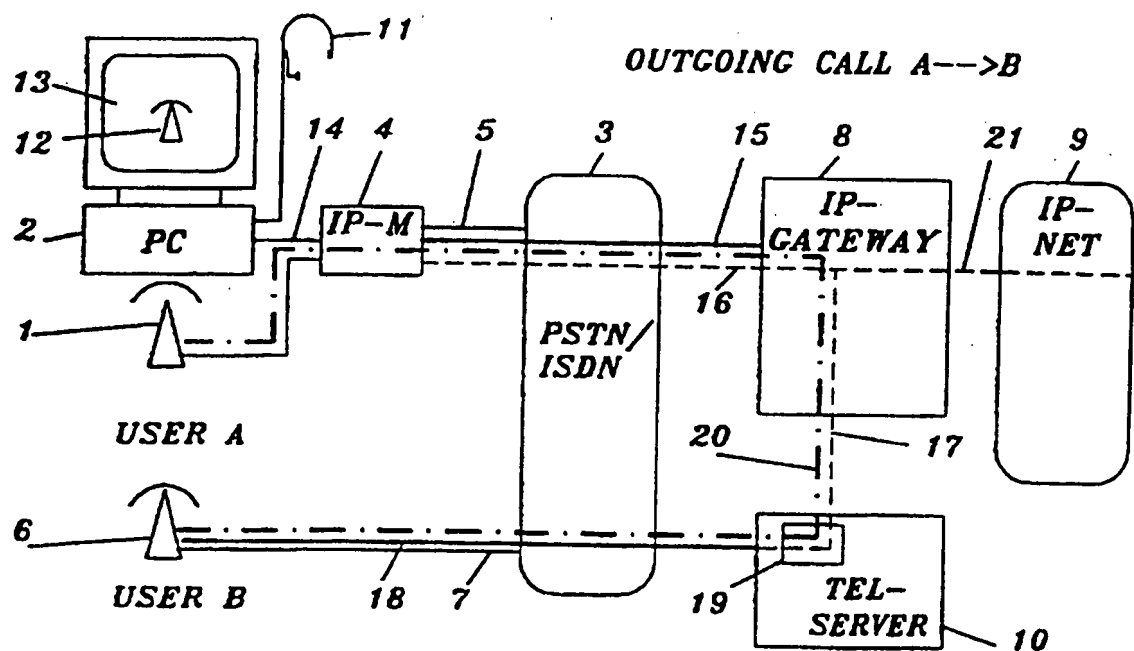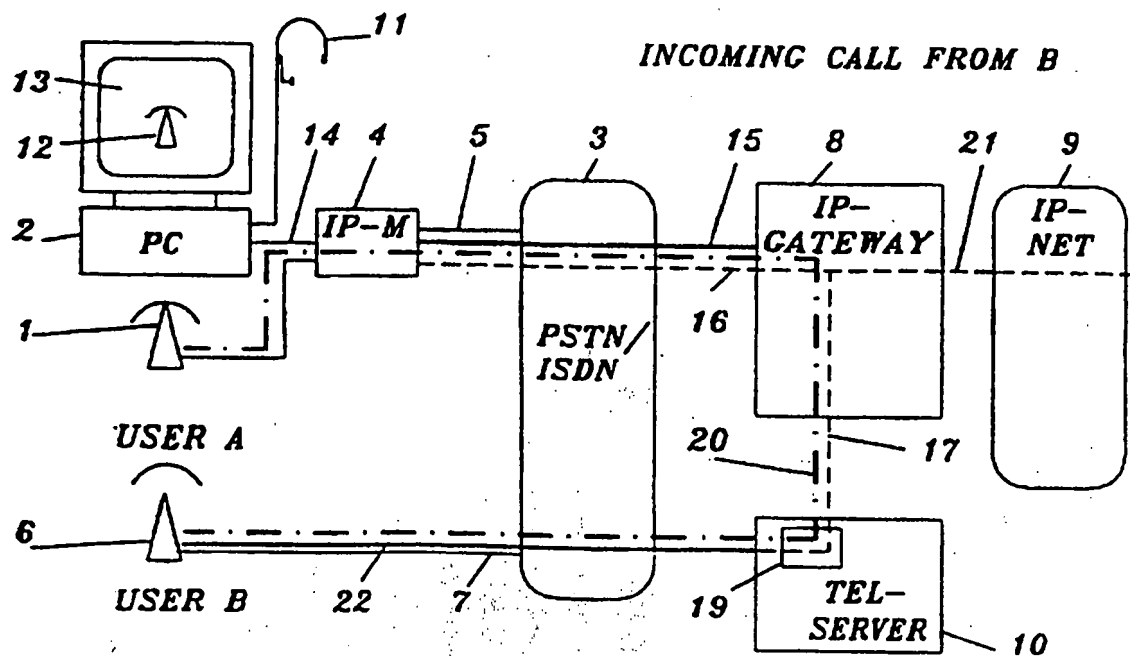
10. A modem in accordance with claim 4 characterized in that it further comprises multiplexer/demultiplexer means (80) for multiplexing of voice and data signals to be transmitted on said dialled up connection (15) and for demultiplexing voice and data signals received on said dialled up connection and for directing said demultiplexed signals to the telephony interface (75) and to the PC interface (73) respectively.

11. A modem in accordance with claim 4 characterized in that it comprises at least two telephone interfaces (75, 76) each one connected to a respective telephone loop (57, 58) so as to allow for several independent and simultaneous telephone calls.

12. A modem in accordance with claim 11 characterized in that intercommunication (60) is provided between telephones connected to different telephone interfaces.

13. A modem in accordance with claim 11 characterized in that intercommunication (63) is provided between a telephony application (13) running on a PC (2) connected to said PC interface (73) or said LAN interface (74) and any one of the telephones connected to the different telephone interfaces.

OUTGOING CALL A-->B

FIG.1
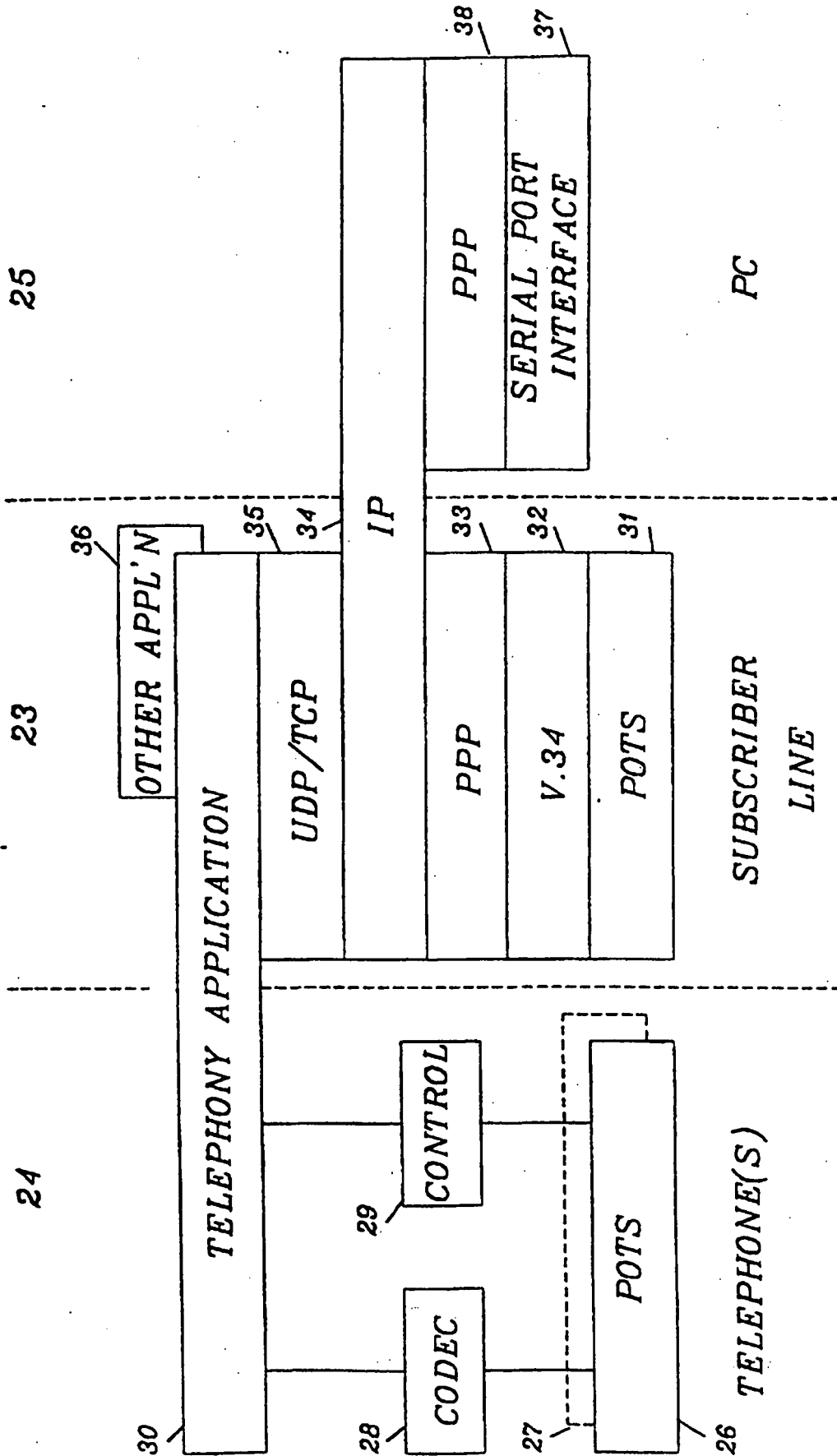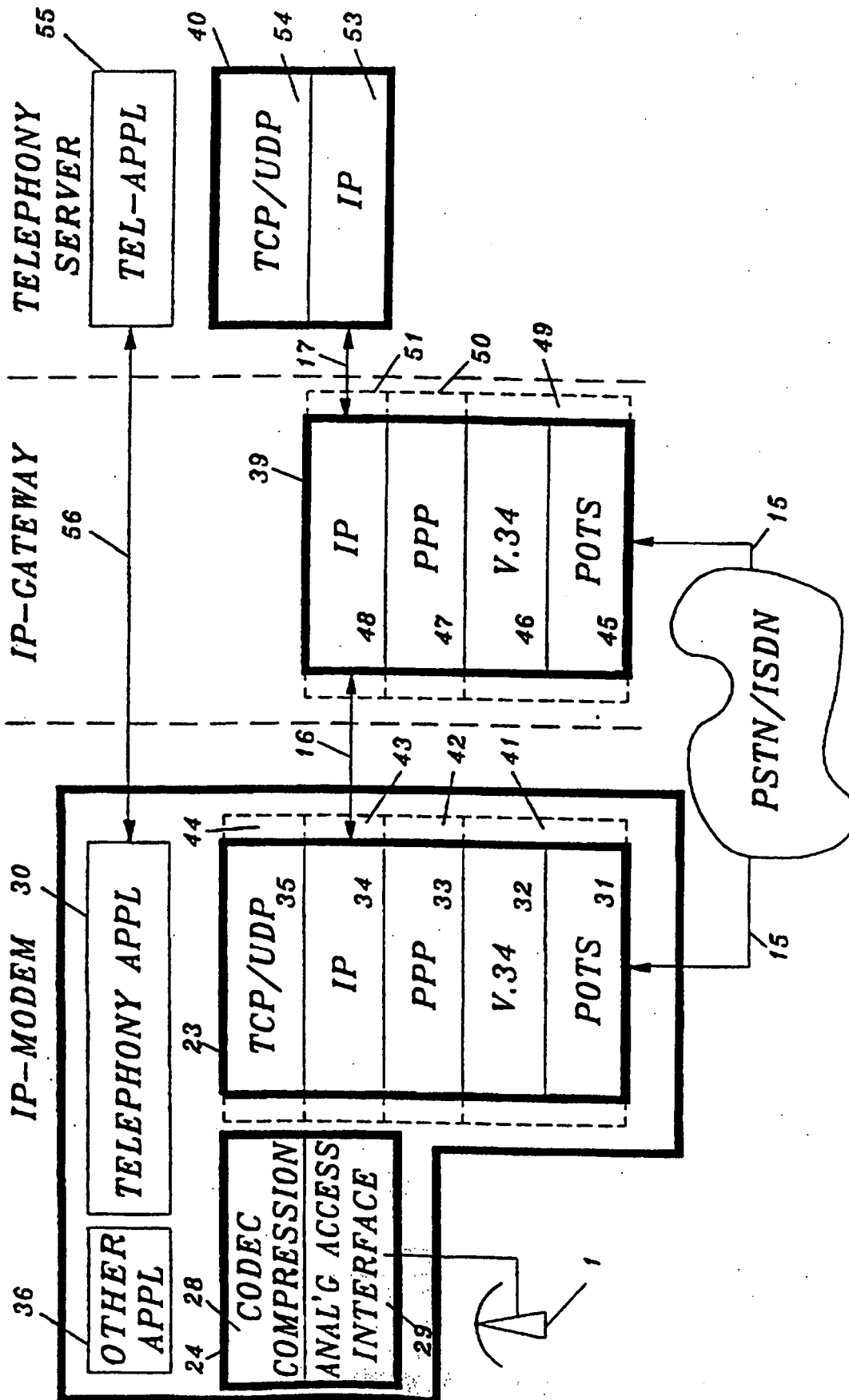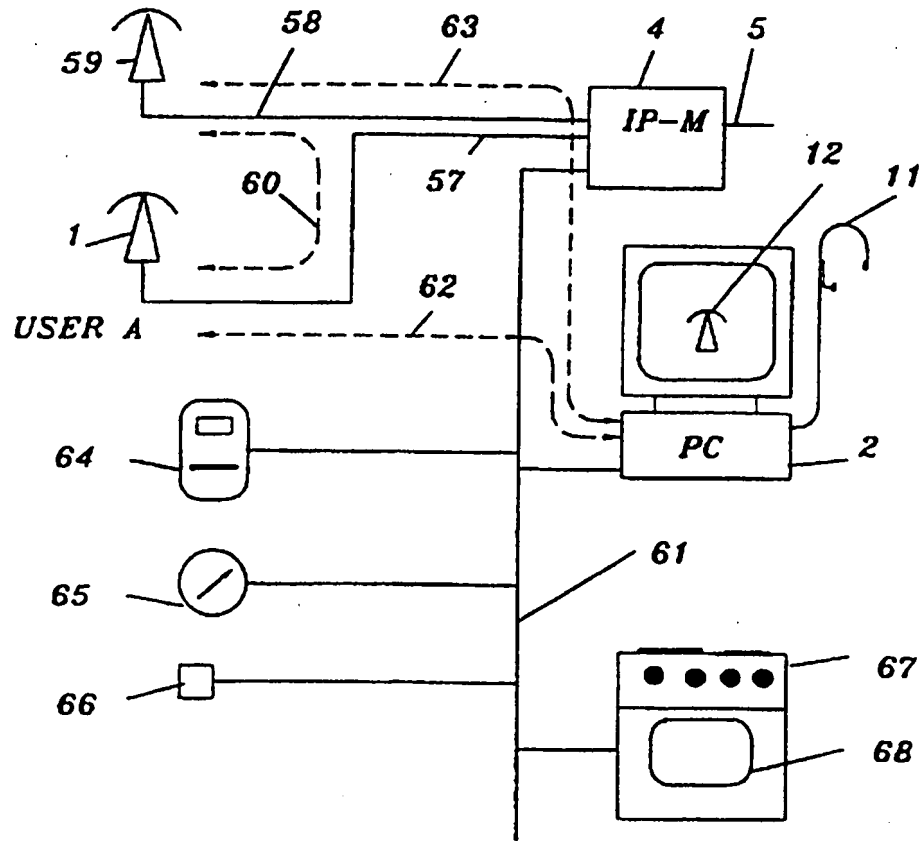

INCOMING CALL FROM B

FIG.2

FIG. 3

FIG. 4

FIG.5

TO PC ←

4

70

69

TO WALL
SOCKET

72

71

FIG.6

4

81

CONTROLLER

TO 61 →

73

LAN

74

80

78

79

PC
INTERFACE

IP
ROUTER

APPL'N
HANDLER

TO 2 →

TO 58 →

76

75

77

TELEPH
INTERFACE

SUB.LINE
INTERFACE

TO 57 →
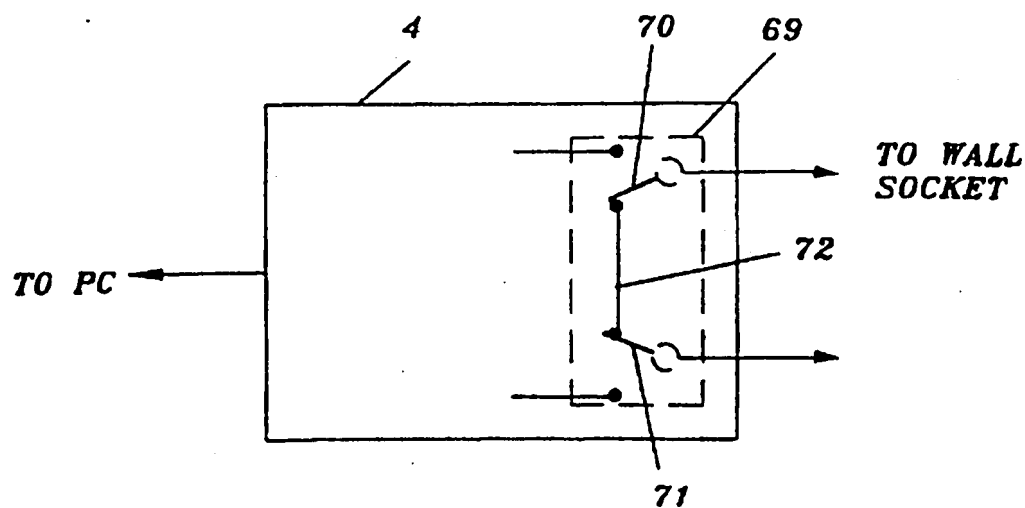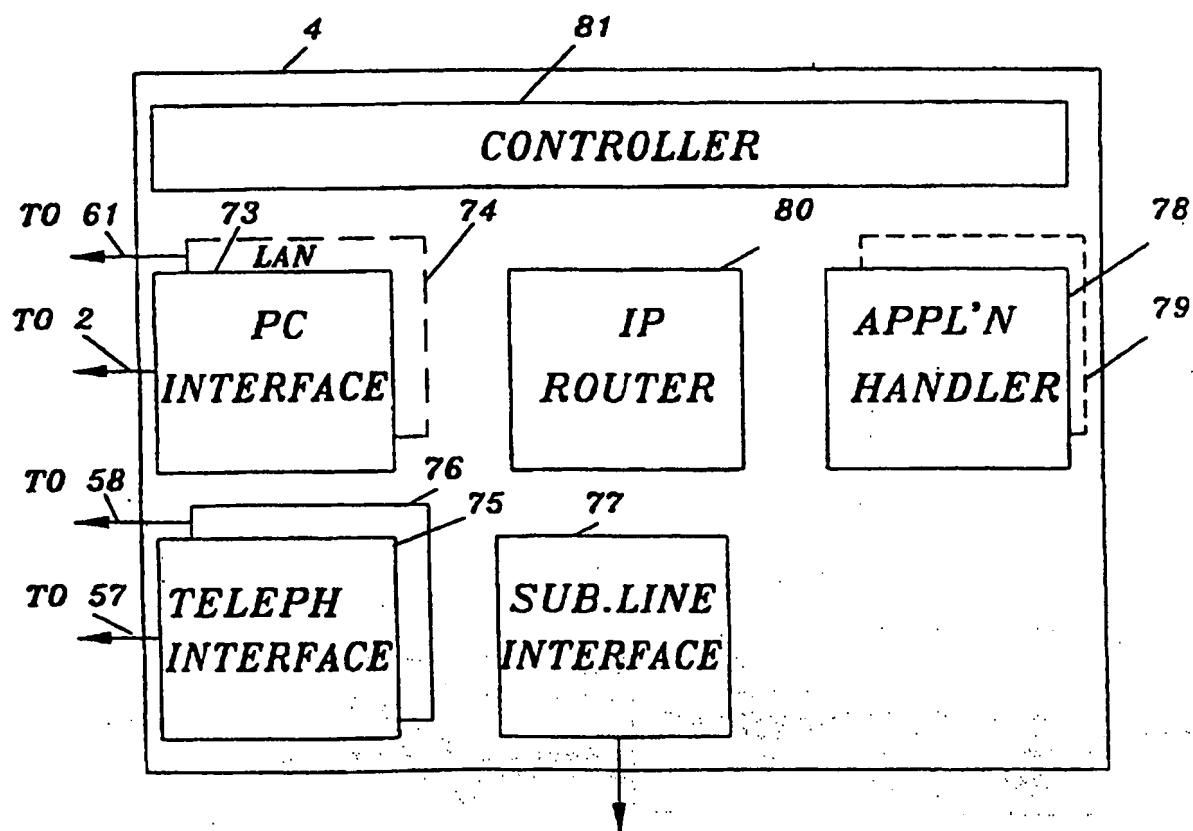
FIG.7
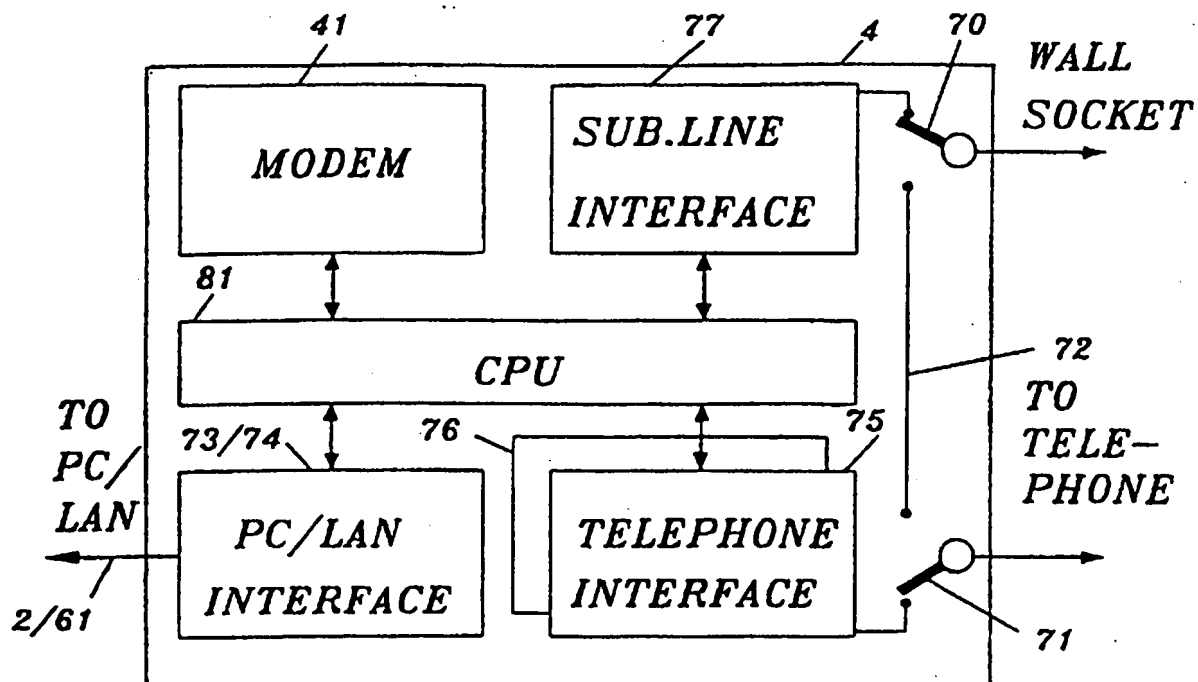
FIG.8
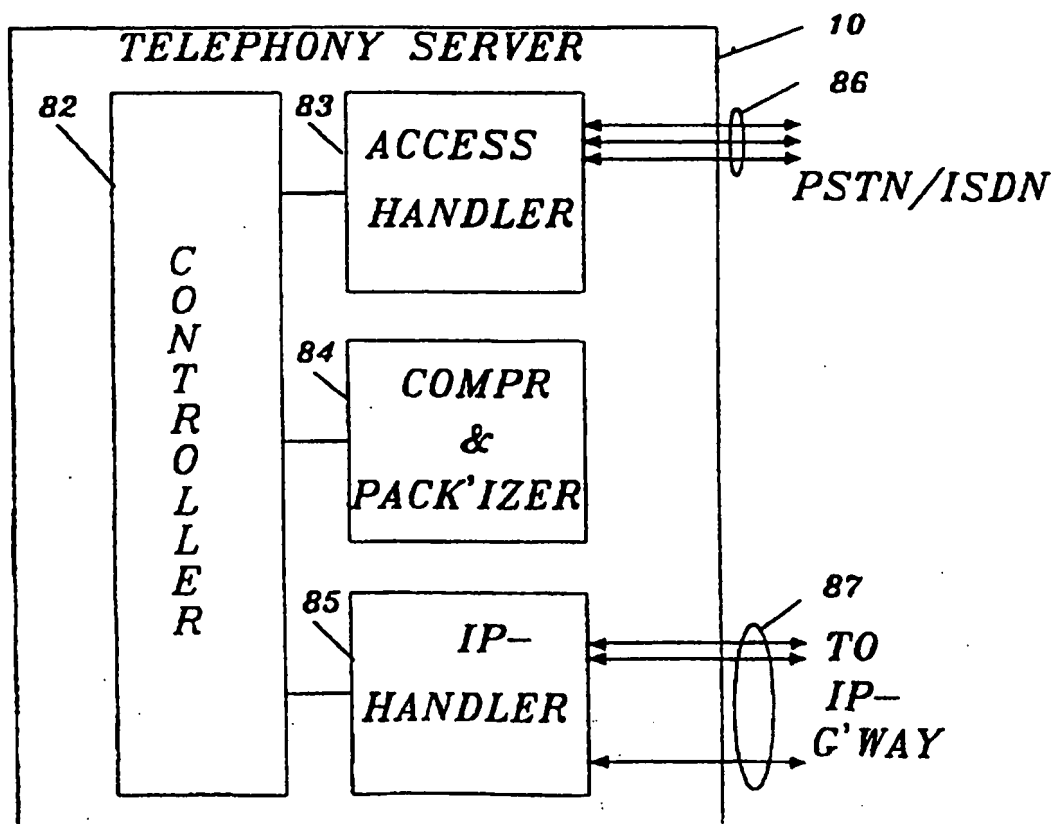
FIG.9

INTERNATIONAL SEARCH REPORT	International application No.
	PCT/SE 97/00968

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04M 11/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04M, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y		4-13
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Y	US 5513251 A (ROCHKIND ET AL), 30 April 1996 (30.04.96), column 3, line 42 - column 5, line 16, figure 1	4-13
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P,Y	WO 9620553 A2 (ALPHANET TELECOM INC.), 4 July 1996 (04.07.96), page 2, line 31 - page 4, line 4	4-13
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[X] Further documents are listed in the continuation of Box C.   [X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 October 1997	06 -11- 1997
Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00968

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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P,A	US 5625677 A (FEIERTAG ET AL), 29 April 1997 (29.04.97), column 1, line 10 - column 2, line 49	1-13
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				US	5608786	A	04/03/97
US	5428608	A	27/06/95	NONE			
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				CN	1115530	A	24/01/96
				IL	113236	D	00/00/00
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US	5625677	A	29/04/97	NONE			
EP	0777364	A2	04/06/97	ES	1032074	U,Y	16/03/96